



# American Conservation Experience

2900 North Fort Valley Road, Flagstaff, AZ 86001

## ACE Project Report for White Cliffs Trail Construction Phase 1

**Title of Project:** City of Kingman,

**White Cliffs Trail Constructions**

**Project Partner:** Michael Meersman

**Location:** White Cliffs Wagon Trail,  
City of Kingman

**Dates:** 11/29/2020 - 2/20/2021

**Crew Supervisors:** Kiersten Bonesteel  
& Kyle Brownrigg

**Days worked:** 50

**Total Crew Hours:** 2990



### Project Description

Nestled between Kingman's Historic Downtown and The City Golf Course lies a piece of American History. The Historic White Cliffs Wagon Trail dates back to the 1870's when miners would transport ore from the Stockton Hill Mine in heavy wagons. The canyon is home to vibrant desert vegetation and a wide variety of local wildlife. Over the years the area has fallen victim to graffiti and trash dumping. By creating an established trail system we hope to bring more attention to this area as a unique resource within the city limits and spur on a new wave of environmental stewardship within the community. The initial design was done by members of the Colorado River Trail Association. The design focuses on utilizing the natural terrain just past the Historic White Cliff Wagon trail for hikers and mountain bikers. The final goal of the White Cliffs project will be to create an additional 6 miles of trails that will connect the historic downtown area to the city golf course.



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## Accomplishments:

- 1.232 Miles of New Trail
- 1.03 Miles of Quality Control
- 359.25 Cubic Feet of Retaining Walls
- 4 Armored Drain Pans
- 172 Cubic Feet of Rock Crushed
- 4 Rocks Quarried
- 1 Boulder Removed with Boulder Buster
- 71 Large Rocks Removed
- 6 Rocks moved by Rigging



## Crew Demographics:

### Breakdown by Gender:

Male: 10

Female: 10

Not Identified: 0

### Breakdown by Race:

Not Identified: 0

White American: 19

Asian American: 1

### Breakdown by Age:

18: 0      24: 1

19: 1      25: 1

20: 0      26: 1

21: 0      27: 0

22: 1      28: 1

23: 1      29: 0

Undeclared: 13





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The intended layout maximized the natural contouring of the landscape in a way that would minimize any potential alterations to the natural hydrology of the area. However, this led to several challenges along the way. As the crews worked their way back North along the western canyon wall they encountered massive rock fields, large wash crossing, and intensive rock work projects. Above is a picture of one of the rock fields that the trail was constructed through. In order to construct the trail the crew utilized a wide range of tools including grip hoists and rock bars to clear rock from the trail corridor.



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The first step that needs to be completed on any new trail construction is clearing out the corridor for the trail. The corridor size varies based on the intended user groups. Corridor clearing traditionally focuses on removing vegetation, but during the White Cliffs project the majority of the corridor was blocked by large chunks of stone. Members primarily used rock bars to roll rocks out of the intended corridor.



Rocks bars provide the user with additional leverage by utilizing a fulcrum close to the rock being moved. This fulcrum creates a pivot point near the end of the bar allowing the member to lift large stones with greater ease. When two, or more, rock bars are working together rocks that seem immovable can easily be moved so long as the proper amount of force is being exerted. For safety, our crews will utilize rock bars to establish the final setting of a rock so as to avoid the risk of catching their hands between the rock being set and any other objects.





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## Dry Stone Rock Work: Retaining Wall

The first step of constructing any rock structure is to dig out a space for the rock to sit in the ground. This space allows builders to create a foundation where the rocks can rest flat against the ground without moving. It also allows for the rock to be set lower into the ground. This is called digging the footing. In the picture below, one of our members works on digging a footing for single tier retaining wall.



Sometimes, we encounter bedrock when we dig a footing. Bedrock can be both advantageous when constructing a rock structure and an inconvenience. Above, one of our members utilizes a hammer drill to chip away at the bedrock. Once the bedrock is shaped back the next step will be to start setting/placing rocks into the first tier of the wall.





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## Dry Stone Rock Work: Retaining Wall

### Before

The picture to the right shows where the new trail will be. The reason for a retaining wall in this situation is to ensure that the tread is reinforced and won't erode away. The wall must be solid with good contact points between the rocks to ensure that water and trail users can't damage the structure.



### After

Once the rocks that make up the body of the wall have been set securely into the footing we crush in behind the structure. We make crush by breaking rocks into smaller chunks. The crush increases the number of contact points between the load bearing components of the structure making it more secure. More contact points means that there is a greater amount of friction present to hold the rocks in place. The photo to the left shows the completed structure.





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## Dry Stone Rock Work: Rock Ramps



### Before

When there is no soil present to build on we can construct a stone ramp which will allow us to create an erosion resistant tread surface that will also help us to gain elevation. In the picture to the left the crew was tasked with tying the new trail into the preexisting trail. Where the trails met the new trail was 3 feet higher than the existing trail and required a structure to be constructed.



The first step of constructing a stone ramp is the same as that for a retaining wall. Once your footings are dug the next step is to construct a frame for the ramp. The purpose of the stone frame is to create a closed area in which to begin armoring the tread surface. To the left, you can see one of our staff members working on finishing the frame for the ramp.





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## Dry Stone Rock Work: Rock Ramps

After completing the frame and ensuring that all of the stones are set properly it is time to begin armoring the tread for the ramp. To do this we begin setting rocks into the trail on a slight upward angle. We fill the space beneath these stones with crush in order to create a surface for the stones to rest on. There are two types of armoring that can be done. To the right, you see a process called flag stoning. Rocks are laid flat so that they cover the most surface area possible. Each of the set stones must be contacting every stone next to it to ensure a sturdy structure. Once the pad is set the crew crushed in between each of the stones. As crush is added the pad locks together within the frame.



### After

To the left is the finished construction. The ramp is made up of an exterior retaining wall and an armored tread surface. The final step of this project was to put dirt on top of the armored tread. Over time, the soil that was added will compact down to fill any additional gaps while making the structure appear more natural as opposed to constructed.





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## Cutting Tread: Rock Breaking



At times a pick mattock wasn't enough to cut the tread because of large veins of bedrock. When faced with such an obstacle we turn to the heavy equipment. For rock breaking operations we utilize hammer drills as well as a hydraulic rock breaker. The mechanical advantage provided by both allow us to shape large rocks and bedrock quickly and efficiently.

Top Left & Bottom Left: Two person team utilizing the hydraulic rock breaker to cut tread through a vein of bedrock

Top Right: One of our members fine tuning a section of trail that crosses a sand stone shelf with the hammer drill.





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## Cutting Tread: Boulder Buster



Every so often there is one rock just too large for us to break with hammer drills and hydraulic rock breakers. One such example was this 1500 lb boulder that sat directly in the center of our intended trail (top left). In order to remove the obstacle we utilized a specialized tool known as a "boulder buster".



Before the boulder buster could be used the crew, under staff supervision, had to drill a 1.5 inch diameter hole into the rock (bottom left). While boring the hole it is important to frequently pull the bit back out of the stone to clear the bit of fine rock dust. Once the hole is bored it is then filled to the top with water. A specialized shell is then placed into the hole. This shell contains a specific amount a blasting powder and is designed to go off when a concussive force is exerted upon it.





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## Cutting Tread: Boulder Buster

Once the hole has been bored, filled, and the shell has been placed the crew prepared the detonation mechanism. This metal box is designed with a metal extension that fits on top of the specialized shell (top right). Once in place, the crew primed the mechanism and set the pull cord. Once in cover and having ensured that the area is clear of personnel the cord is pulled. This releases a small hammer that triggers the reaction. The firing of the shell causes the water in the hole to rapidly expand outwards, cracking the rock (bottom left).

Once the "all clear" has been given the fractured sections can be cleared from the tread surface. Much of the boulder fragments went into the construction of the tread surface itself. Those who hadn't seen the boulder there before would never realize that it had ever been there to begin with (bottom right).







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## Cutting Tread: Quality Control



The final step of any project is performing quality control. While our crews maintain a high level quality over the course of a project there will always be a few things that slip through the cracks. Once the main construction has been completed our crew walked back through their work and improved any section that did not meet the standards set both by our project partners and ourselves. This could be anything from the tread being too narrow to a tree branch reaching into the corridor. It is the attention to detail that ensures that users enjoy an immersive experience on a sustainable trail that will withstand the erosive forces of the Eastern Mojave Desert.

